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NACA RESEARCH MEMORANDUM

THE EFFECT OF REAR CHINE STRIPS ON THE TAKE-OFF CHARACTERISTICS OF A HIGH-SPEED AIRPLANE FITTED WITH NACA HYDRO-SKIS

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NATIONAL ADVISORY COMMITTEE FOR AERONAUTICS

WASHINGTON
March 17, 1949

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THE EFFECT OF REAR CHINE STRIPS ON THE TAKE-OFF CHARACTERISTICS OF A HIGH-SPEED AIRPLANE FITTED WITH NACA HYDRO-SKIS

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SUMMARY

Results are presented from tank take-off tests of a dynamic model of a hypothetical high-speed airplane fitted with NACA hydro-skis and having the transverse curvature of the lower rear portion of the fuselage broken by small longitudinal chine strips. For the configuration tested, both trim and resistance were considerably reduced by the addition of the strips from the speed at which the ski emerged to the speed at which the rear of the fuselage came clear of the water. The results indicate that fuselage shape has a large effect on the take-off characteristics for a hydro-ski configuration in which the rear of the fuselage acts as a planing surface.

INTRODUCTION

The results of some model investigations with retractable planing surfaces, called hydro-skis, used to support high-speed jet-propelled water-based airplanes during the high-speed parts of their take-off and landing runs are presented in references 1 and 2. As was mentioned in reference 2, some differences were found to exist between the data presented in reference 1 and those presented in reference 2 although the models tested were thought to be identical. It was found that small deformations occurring in the model could cause these differences. In the course of the investigation during which this fact was determined, configurations were tested which showed significant changes in the take-off characteristics. Results of the tests of one such arrangement are reported in the present paper.

The tests were made in Langley tank no. 2 by use of a $\frac{1}{12}$-size model of the hypothetical transonic airplane described in reference 3. Sturdy construction prevented the occurrence of deformation in this model.

TESTING PROCEDURE

The configuration of the model and skis was the same as that reported in reference 2, although the longitudinal nose strips and the simulated jet power were not used for the present tests.

Several arrangements were tested with strips of various lengths added to the lower rear portion of the fuselage to simulate shape deformities. No attempt was made to evaluate completely the many arrangements possible so as to obtain the optimum shape; however, the results presented herein are for the optimum arrangement of those tested.

The tests were made at a gross load of 13,140 pounds (full size) with fuselage bare and with fuselage modified by the addition of chine strips. The configuration and the strips tested are shown in figure 1.

The strips were right triangular in shape with equal legs $\frac{3}{4}$ inch full size. They were mounted symmetrically on either side of the fuselage with the hypotenuses of the right triangles tangent to the fuselage and were extended forward from the rear to a point just beneath the trailing edge of the wing root (16.75 feet, full size). They were set so that the lines bisecting the two right angles would intersect at an angle of 90° at the center of the semicircle which formed the fuselage bottom.

The tests were run with the same setup as that used in reference 1. (See fig. 2.) In these tests, the model was towed at constant speeds from its center of gravity about which it was free to trim. It was also free to rise. The resistance and trim of the model were measured. Flaps were set at 0° for speeds below ski emergence and deflected 20° for speeds above ski emergence. (See reference 1.) The elevators were deflected 30° up because the controls could not be varied during the test runs, and this position of the elevators gave reasonable trims near take-off speed.

RESULTS AND DISCUSSION

The effect on the resistance and trim of a hydro-ski configuration obtained by changing the fuselage shape with the addition of rear chine strips is shown in figure 3. From the speed at which the skis emerged to the speed at which the rear of the fuselage left the water, the trims were considerably reduced, apparently because of the breaking of the suction on the rear. The maximum trim was reduced from 21° to 16°, a reduction of about 25 percent. The resistance was correspondingly reduced over the same range of speeds, the reduction of maximum resistance being about 35 percent.

It can be seen that for a hydro-ski configuration in which the rear of the fuselage acts as a planing surface, the shape of this fuselage has a large part in determining the take-off characteristics. A small change, such as the strips used in these tests, can change the performance appreciably by making the streamline body a more effective planing surface.

CONCLUSIONS

Tests with a dynamic model of a hypothetical high-speed airplane fitted with NACA hydro-skis and having the transverse curvature of the lower rear portion of the fuselage broken by small longitudinal strips ($\frac{3}{4}$ inch wide, full size) indicate the following conclusions:

1. The trims from the speed at which the ski emerged to the speed at which the rear of the model came clear of the water were considerably reduced, the reduction of maximum trim being about 25 percent.

2. The resistance was reduced over the same range of speeds, the maximum resistance being reduced about 35 percent.

3. The take-off characteristics for a hydro-ski configuration in which the rear of the fuselage acts as a planing surface are to a large degree determined by the fuselage shape.

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2. Wadlin, Kenneth L., and Ramsen, John A.: Tank Spray Tests of a Jet-Powered Model Fitted with NACA Hydro-Skis. NACA RM No. L8B18, 1948.

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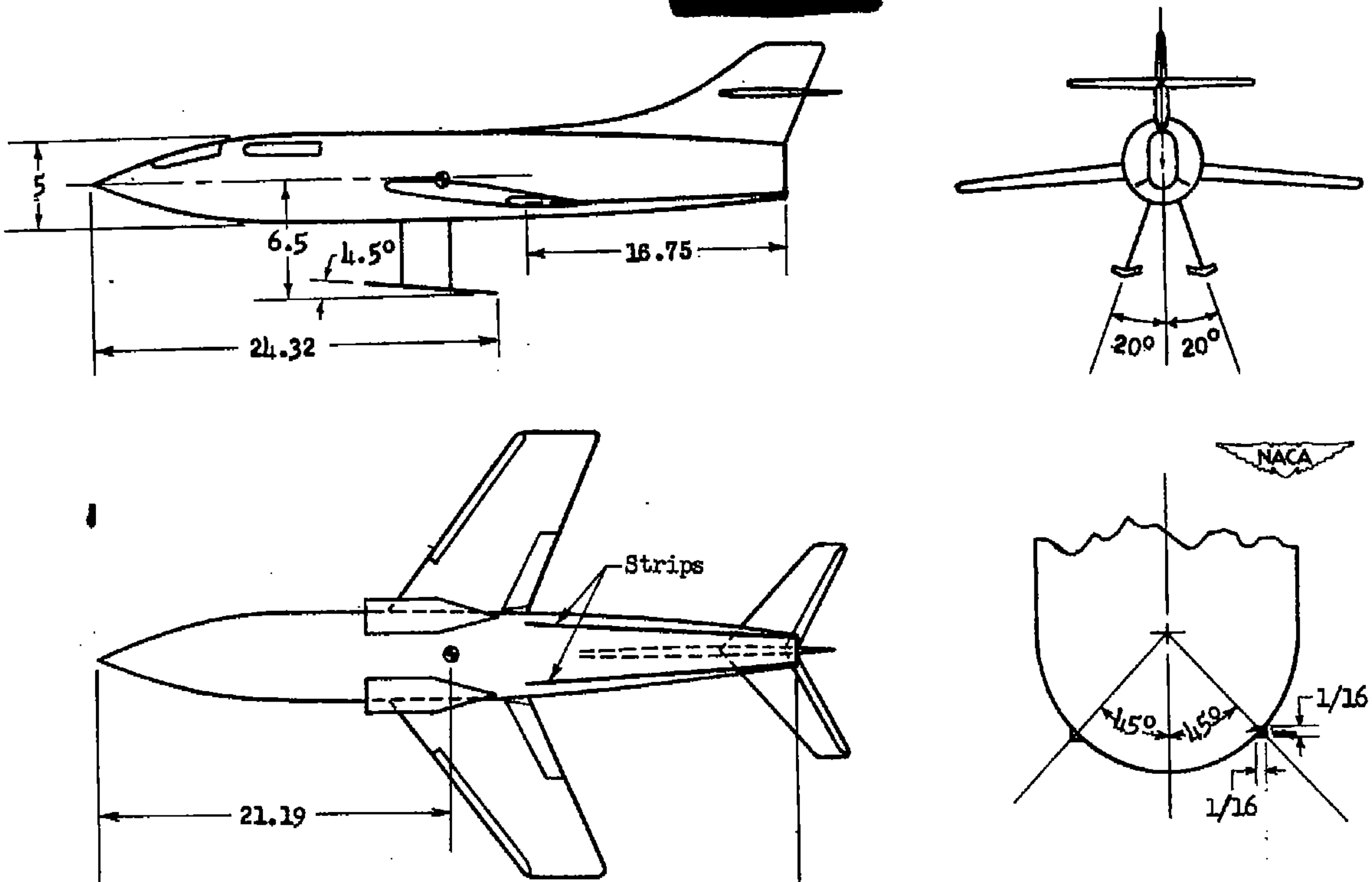

Details of strip location

Figure 1.- Drawing of model fitted with NACA hydro-skis and rear chine strips. (Dimensions are inches, model size; feet, full size.)

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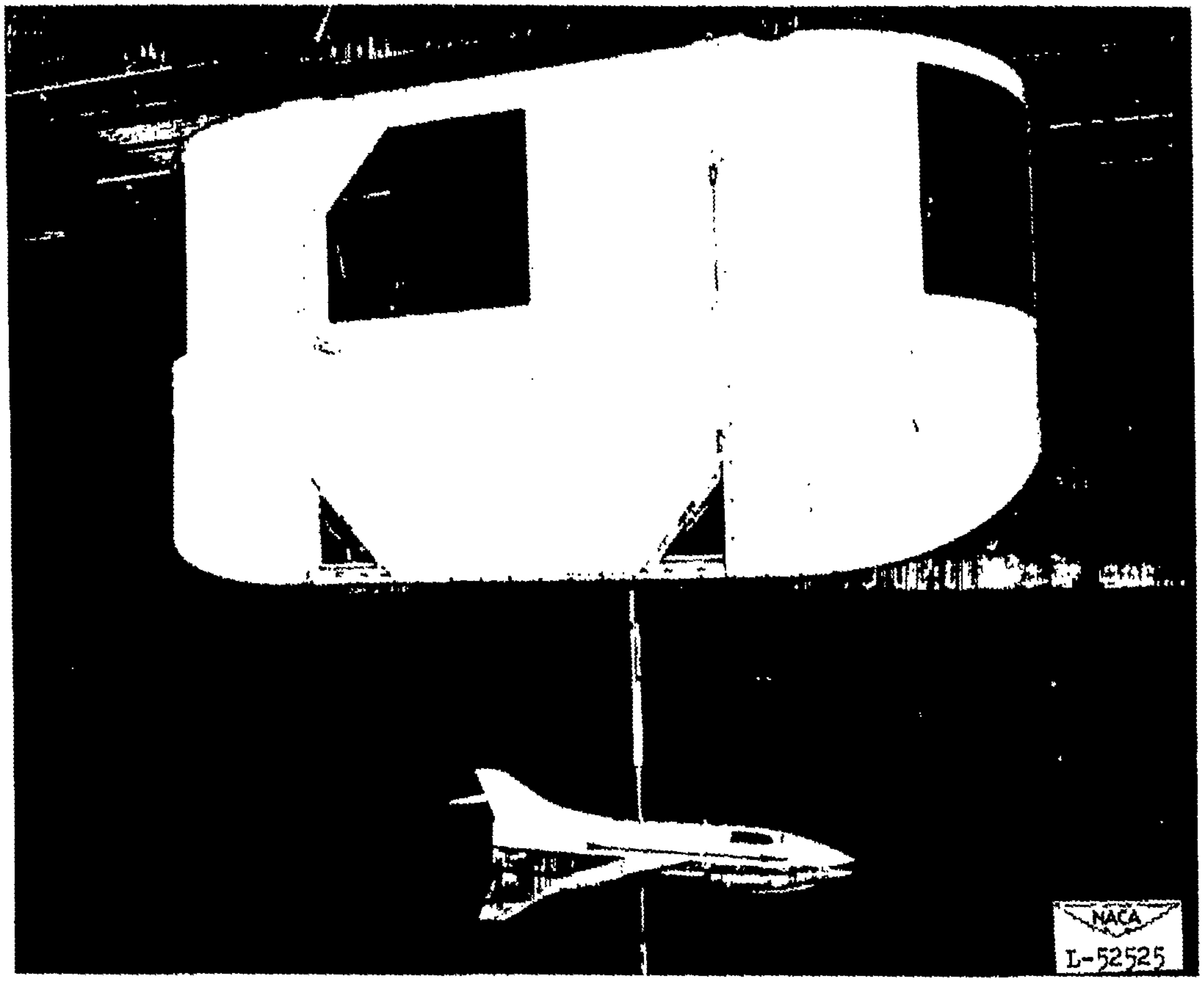

Figure 2.- Test setup showing model floating at take-off weight.

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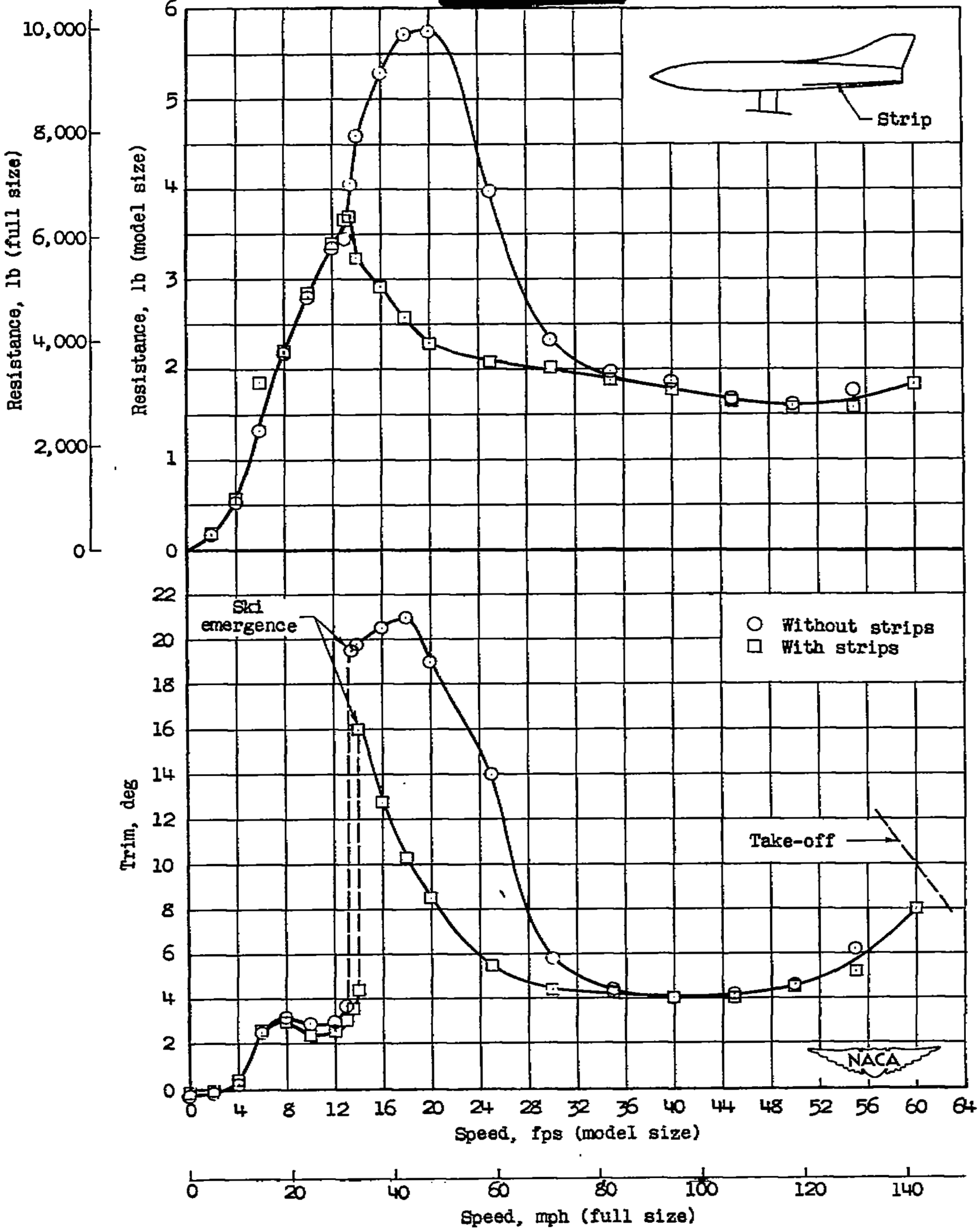

Figure 3.- The effect of rear chine strips on the resistance and trim of a hydro-ski configuration.

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